



Integrated Systems Research Program

The Integrated Systems Research Program, part of NASA's Aeronautics Research Mission Directorate, conducts research on promising aeronautical concepts and technologies for use in the air transportation system of the future.

As the Next Generation Air Transportation System (NextGen) evolves, researchers must address the national challenges of mobility, capacity, safety, security, energy and the environment in order to meet the expected growth in air traffic.

The Integrated Systems Research Program focuses on maturing and integrating NextGen technologies into major vehicle/operational systems and subsystems that will address these national challenges.

Using a system-level approach, NASA researchers explore, assess and demonstrate the benefits of those technologies in a relevant environment.

By focusing on technologies that have already proven their merit at the foundational level, this program will help transition them more quickly to the aviation community, as well as inform future foundational research needs.

The program synchronizes its work with the long-term, foundational research conducted by other programs within the directorate, and closely coordinates with research efforts of other federal government agencies.



Images (Clockwise, left to right) **Hybrid Wing Body:** This advanced aircraft design concept where the wing blends into the vehicle's body can significantly reduce fuel consumption and noise. **Wind Tunnel Tests:** NASA, in partnership with Boeing and the Air Force Research Laboratory, test a subscale model of a hybrid wing body aircraft. **Strut-Braced Wing:** An example of a NASA alternative vehicle concept with engines mounted on pylons over the wings in order to provide more shielding against engine noise and reduce weight and drag. **Supersonic Cruise:** An advanced design concept for a supersonic cruise aircraft that reduces the level of sonic booms enough to allow travel over land.

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RESEARCH AREAS

Environmentally Responsible Aviation Project

The primary goal of this project is to select vehicle concepts and technologies that can simultaneously reduce fuel burn, noise and emissions. It contains three subprojects: Airframe Technology, Propulsion Technology and Vehicle Systems Integration.

Major research challenges include:

- Documenting the feasibility, benefits and technical risks of vehicle concepts;
- Determining the safety implications of new technologies and configurations;
- Exploring the performance characteristics of design concepts for aircraft that could enter service by 2025; and
- Enlarging the viable trade space—the degree to which performance objectives can be traded against each other to achieve best value—to assist industry in designing and building environmentally efficient vehicles for commercial aviation.

SUBPROJECTS

Airframe Technology

This subproject addresses lightweight structures, flight dynamics and control, and drag and noise reduction. Its primary research goals are to reduce noise, as well as drag and weight in order to reduce fuel burn.

Lightweight Structures: Near-term goal is to demonstrate a new structural concept—a damage-tolerant, stitched composite—that can be used to build lighter-weight and lower-cost composite wing and fuselage structures.

Flight Dynamics and Control: Near-term goal is to develop a full-scale, piloted, motion-based simulation capability of an existing hybrid wing body vehicle that can be used to explore its control power allocation and handling and ride qualities requirements.

Drag Reduction: Near-term goal is to investigate technologies that can reduce overall drag on an aircraft by utilizing laminar flow control, where air flow over a significant portion of the wing is made smooth instead of turbulent, thereby reducing fuel burn.

Noise Reduction: Near-term goal is to flight test technologies that reduce noise during landing, including fairings on landing gear and continuous mold-line technology that eliminates gaps between flaps, ailerons and wings.

Propulsion Technology

This subproject addresses technologies for improving engine performance including high-pressure engine-core components

and propulsor technologies. Its primary goals are to reduce noise, nitrogen oxide (NOx) emissions and fuel burn.

Combustor Technology: Near-term goal is to conduct a series of experiments on innovative combustor and injector designs to see how well they improve fuel/air mixing, thereby reducing NOx emissions.

Propulsor Technology: Near-term goal is to test the performance of the best available propulsor systems—open rotor and ultra high bypass ratio turbofans—on reducing fuel burn and aircraft noise.

Core Technology: Near-term goal is to test several advanced technologies to further improve the thermal efficiency of gas turbine engine cores and reduce fuel consumption.

Vehicle Systems Integration

This subproject identifies the best ways to integrate promising airframe and propulsion technologies.

Systems Analysis: Near-term goal is to conduct a broad survey of technologies with the most potential to reach a high level of readiness by 2015 and to simultaneously meet noise, emissions and fuel burn reduction goals.

Propulsion Airframe Integration: Near-term goal is to conduct wind tunnel tests of different engine and airframe configurations in order to identify their ability to address integration challenges.

Propulsion Airframe Aeroacoustics: Near-term goal is to conduct tests to identify the noise-reduction potential of advanced aircraft designs.

Advanced Configurations: Near-term goals are to examine the efficiency of current vehicle operations in the National Airspace System, and to identify those advanced vehicle concepts with the most potential for achieving environmentally responsible aviation goals.

We're Working on...

Testing unconventional aircraft configurations that have higher lift to drag ratio, reduced drag and reduced noise around airports

Achieving drag reduction through laminar flow

Developing composite (nonmetallic) structural concepts to reduce weight and improve fuel burn

Testing advanced, fuel-flexible combustor technologies that can reduce engine NOx emissions

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For more information about the Integrated Systems Research Program and NASA aeronautics research, visit www.aeronautics.nasa.gov/programs_isrp.htm.

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